

CMMI*, The GSFC Process Improvement Project and Code 300

(*Capability Maturity Model-Integrated)

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Agenda



- BRIEF view of the CMMI
- Use of CMMI model at GSFC Our GSFC Process Improvement Project
- Relationship between these activities and Code 300.

What is CMMI?



The Capability Maturity Model Integrated (CMMI) is an integrated framework for maturity models and associated products that integrates the two key disciplines that are inseparable in a systems development activity: software engineering and systems engineering.

A common-sense application of process management and quality improvement concepts to product development, maintenance and acquisition

A set of best practices

A community developed guide

A model for organizational improvement

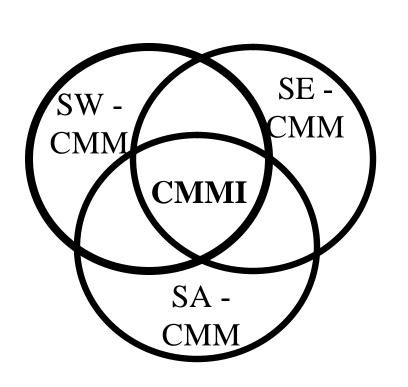
Why Use CMMI?



- In software and systems engineering, it is a **benchmarking tool** widely used by industry and government, both in the US and abroad.
- CMMI acts as a roadmap for process improvement activities.
- It provides criteria for reviews and appraisals.
- It provides a reference point to establish present state of processes.
- CMMI addresses practices that are the framework for process improvement.
- CMMI is not prescriptive; it does not tell an organization how to improve.

Capability Maturity Model Integrated (CMMI)-Staged

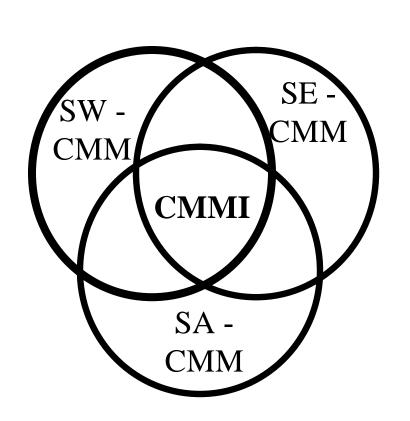




Level	Process Areas
5 Optimizing	Organization innovation and deployment Causal analysis and resolution
4 Quantitatively Managed	Organizational process performance Quantitative project management
3 Defined	Requirements development Technical solution Product integration Verification Validation Organizational process focus Organizational process definition Organizational training Integrated project management Risk management Decision analysis and resolution Integrated Supplier Management Integrated Teaming
2 Managed	Requirements management Project planning Project monitoring and control Configuration Management Supplier agreement management Measurement and analysis Product & Process Quality Assurance
1 Initial	

Capability Maturity Model Integrated (CMMI)-Continuous





Categories	Process Areas
Process Management	Organizational process focus Organizational process definition Organizational training Organization innovation and deployment Organizational process performance
Project Management	Project planning Project monitoring and control Integrated Supplier Management Integrated project management Quantitative project management Risk management Integrated Teaming Supplier agreement management
Engineering	Requirements development Requirements management Technical solution Product integration
	Verification Validation
Support	Decision analysis and resolution Configuration Management Measurement and analysis Product & Process Quality Assurance

CMMI Staging Continuous vs. Staged

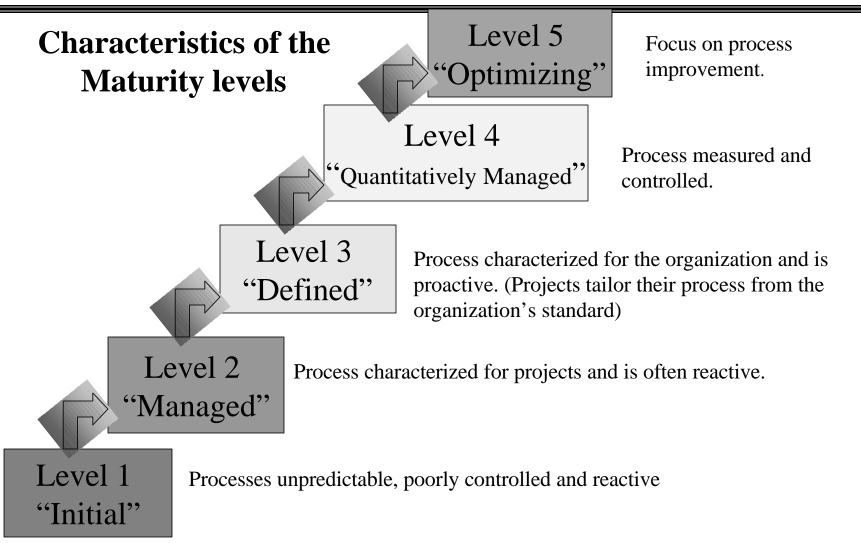


Capability Level	Continuous Model	
0	Incomplete	
1	Performed	
2	Managed	
3	Defined	
4	Quantitatively Managed	
5	Optimizing	

Maturity Level	Staged Model	
1	Initial	
2	Managed	
3	Defined	
4	Quantitatively Managed	
5	Optimizing	

Capability Maturity Model Integrated -Staged

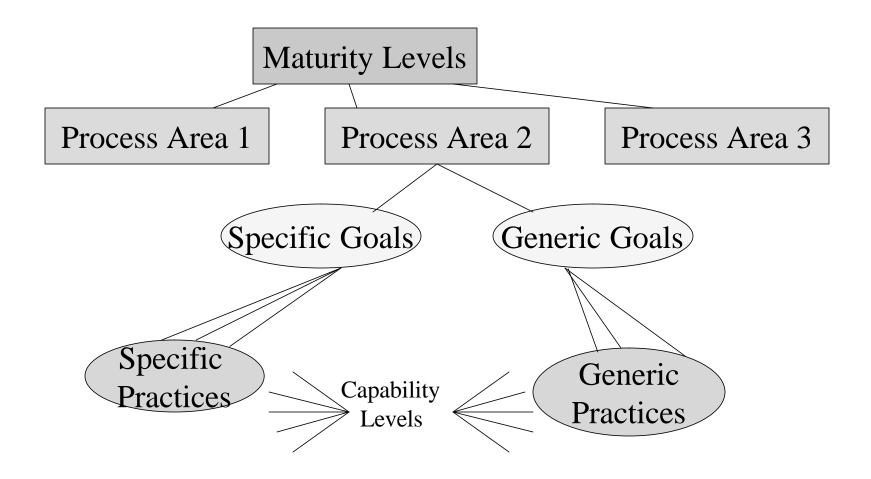




CMM was developed by the Software Engineering Institute (SEI), Carnegie Mellon University (CMU)

Components of CMMI Model





Example Process Area: Requirements Management



SG 1: Manage Requirements

SP 1.1: Obtain an Understanding of the Requirements

SP1.2: Obtain Commitment to the Requirements

SP1.3: Manage Requirements Changes

SP1.4: Maintain Bi-directional Traceability of Requirements

SP1.5: Identify Inconsistencies between Project Work & Reqmts

GG 2: Institutionalize a Managed Process

GP 2.1: Establish an Organizational Policy

GP 2.2: Plan the Process

GP 2.3: Provide Resources

GP 2.4: Assign Responsibility

Example Process Area: Requirements Management



GG 2: Institutionalize a Managed Process

GP 2.5: Train People

GP 2.6: Manage Configurations

GP 2.7: Identify & Involve Relevant Stakeholders

GP 2.8: Monitor and Control the Process

GP 2.9: Objectively Evaluate Adherence

GP 2.10: Review Status with Higher Level Management

GG 3: Define a Managed Process

GP 3.1:Establish a Defined Process

GP 3.2:Collect Improvement Information



Goddard Space Flight Center's

Software Development Process Improvement Project

NASA Software Engineering Initiative



Goal: Advance software engineering practices (development, assurance, and management) to effectively meet the scientific and technological objectives of NASA.

- Strategy 1. Implement a continuous software process and product improvement program across NASA and its contract community.
- Strategy 2. Improve safety, reliability, and quality of software through the integration of sound software engineering principles and standards.
- Strategy 3. Improve NASA's software engineering practices through research.
- Strategy 4. Improve software engineers' knowledge and skills, and attract and retain software engineers.

13

GSFC Software Development Process Improvement Plan



Developed Software Plan to **improve the processes and practices in use at GSFC** using the Capability Maturity Model Integrated (CMMI) as a measure of progress

- -Focuses on Mission Critical Software
- -Signed by GSFC Director

Are working with Systems Engineering to help them pilot CMMI

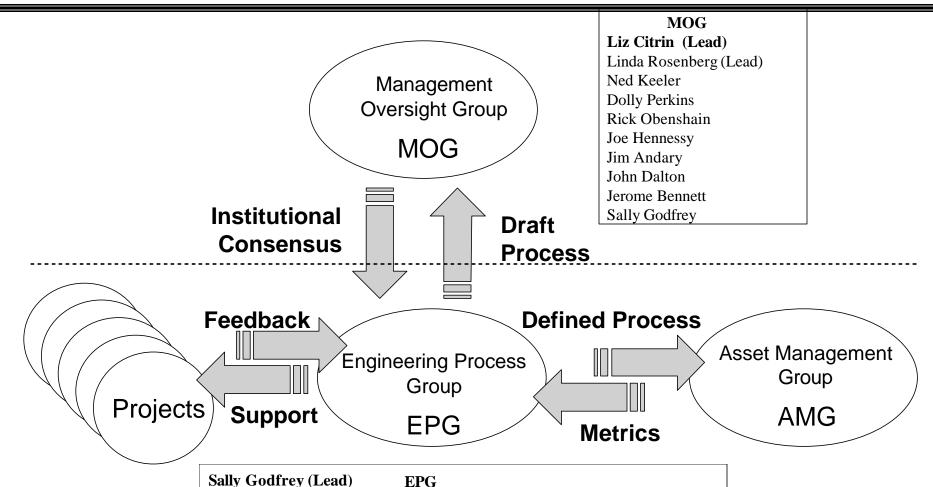
Software Long Term Goals

- -Increase percentage of projects that are on-time and within cost by at least 10%
- -Increase productivity by at least 5%
- -Decrease cycle time by 10-20%
- -Reduce error rate after delivery by at least 20%

Infrastructure



15



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29 April 2003

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Implementation Phases in GSFC's Plan



Phase 1: Pilot Phase (FY02)

- Benchmark several representative GSFC software areas
- Estimate the effort and the cost to improve identified gaps
- Evaluate implementation approach and modify as necessary for a full implementation in Phase 2

Phase 2: Implementation Phase (FY03-FY07)

- Implement process improvement on all mission critical projects
- Use phase-in approach starting with new projects

Phase 3: Maintain Level and Continue Improvement

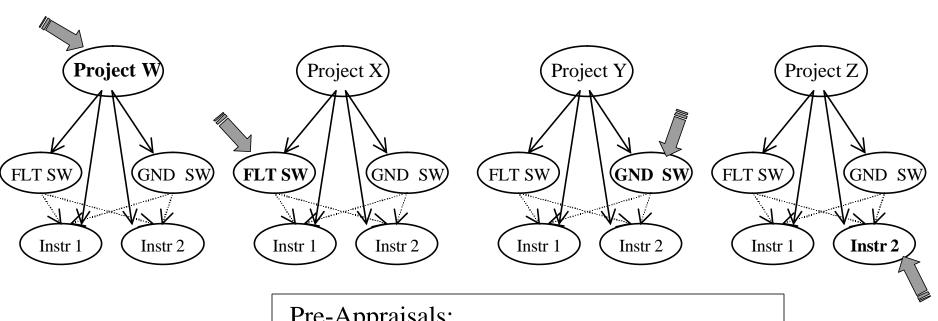
- Maintain achieved levels in existing areas
- Consider including other less critical areas (e.g., science processing)

FY02 FY03 FY04 FY05 FY06 FY07 FY08

PHASE 1 PHASE 2 PHASE 3

Pre-Appraisal Areas Selected for Phase 1





Pre-Appraisals:

- -Flight Software (11/01)
- -Project Level-Focus on Systems Engineering & Acquisition (4/02)
- -Ground Software (9/02)

Phase 1 Pre-Appraisals



- Pre-Appraisal #1: Flight Software 2 projects
 - Both projects in-house, mixed contractor/civil servant teams
 - One project complete with all documentation in place
 - Other project at PDR point (development started under GPG's (ISO))
- Pre-Appraisal #2: Flight Projects 3 projects
 - Project 1: Started 00, in formulation, \$700M, international with multiple spacecraft, of which the core spacecraft will be developed in-house
 - Project 2: Started 91, in implementation, CDR in 99, launch in 04, \$890M, ~30 civil servants, multiple contractors
 - Project 3: Part of program with 3 project series, several launches complete, (turn-key), \$435M, mostly contractors, a few civil servants
- Pre-Appraisal #3: Ground Software 2 projects
 - Both projects in-house, mixed contractor/civil servant teams
 - One project complete with all documentation in place
 - Other project in testing (development started under GPG's (ISO))

What Did We Learn In Phase 1?



- Projects are very dependent on "experts" and problems are dealt with in "hero-mode"
 - Most processes are not documented
 - Little consistency in the way processes are performed
- Many in-house projects are weak in project planning and tracking (e.g., no WBS, no tracking of planned vs. actuals (at subsystem levels), etc.)
- Software quality assurance is weak (e.g., little software assurance done by Code 300, no internal quality assurance, etc.)
- Risk management is not well tracked/managed at the subsystem level

What Did We Learn In Phase 1? cont.



- No collection of measures is being done that could be used for estimation and improvement (e.g., effort expended per phase, causes of errors, effort to fix, etc.)
- Some Projects do very little verification early and depend on intensive testing later to catch errors
 - Industry data shows that errors caught late are much more expensive to fix
- Peer reviews are not done consistently
- Some activities are performed better at the Project level rather than at the subsystem level (e.g., Project monitoring, risk management, etc.)

Proposed Phase 2 Strategies FY03 – FY07



- Focus on improvements in areas where GSFC feels it needs to improve
- Work with Projects/Managers to choose areas where greatest benefit can be obtained
- Begin with improvements to mission critical software, then expand to other mission software
- Begin to assess software acquisition processes to identify improvement opportunities
- Phase in improvements with Projects in early stages

 Continue to use CMMI as a tool to guide improvement

Initial Phase 2 Activities FY03



1. Flight Software:

- Document existing best practices and suggested improvements
- Develop tools, checklists and templates to support consistent use of practices (e.g., requirements inspection procedures, test plan/procedure templates, etc.)
- Conduct training to support the use of improved practices
- Identify and support the collection/analysis of measures
- Continue activities started in FY02 (e.g., risk management, cost estimation, early verification activities, etc.)
- 2. Document best practices for all of Code 580 with associated work products and training using flight software practices as a basis. Use a consistent approach to planning and tracking (e.g., WBS, earned value, risk management, etc.)
- 3. Work with systems engineering representatives to pilot a small process improvement area based on the best practices identified in their NPG
- 4. Baseline software acquisition against the CMMI model to identify candidate improvements
- 5. Document and implement improved software assurance practices



How are the Process Improvement Project and CMMI related to Code 300?

Code 300 is Critical to Success of Improvement Project



- Major Portions of CMMI are Code 300 responsibilities
 - Process Area of Process and Product Quality
 Assurance
 - Process Area of Risk Management
 - Many specific practices are Code 300 performed or led (e.g. in project planning, monitoring and control, verification, validation, etc.)
 - Generic practices in every process area call for objective evaluation of adherence
- Phase 1 Pre-Appraisals identified some weak areas in Code 300 areas

Code 300 Is Already Actively Involved



- MOG was initially led by Linda Rosenberg, then Judy Bruner, both while in Code 300
- EPG membership -first Esmond, now Susan Sekira
- Software Assurance: Susan Sekira is already working to document and improve process and procedures
- Reviews: EPG is working with Code 301 to generate improved review checklists
- Acquisition Practices: EPG is working with Al Gallo and a research task to develop a plan for improving acq. practices.
 Work has begun on identifying what should be included in SOW.
- Cont. Risk Management: Al Gallo gave EPG training
- Ultimately Code 300 will be involved in many other areas through its normal responsibilities

What Now?



- For CMMI model reference go to: http://www.sei.cmu.edu/cmmi/products/models.html
- Can Download CMMI-SE/SW(IPPD)/SS V1.1 Continuous
- Attend a CMMI Overview class or an Introduction to CMMI class for more details
- We are developing an EPG web site that will have assets for improvement project- process assets, training, etc.



Questions?



Back-up Slides

CMMI and ISO



- ISO is a standard, CMMI is a model
- ISO is broad- focusing on more aspects of the business. Initially for manufacturing
- CMMI is "deep"- provides more in-depth guidance in more focused areas (SW/SE/SA)
- Both tell you "what" to do, but not "how" to do it
- But CMMI tells you what "expected" practices are if you are a capable, mature organization
- CMMI provides much more detail for guidance than ISO by including an extensive set of "best practices", developed in collaboration with industry/gov/SEI
 - -CMMI provides much better measure of quality of processes; ISO focuses more on having processes
 - -CMMI puts more emphasis on continuous improvement
 - -CMMI allows you to focus on one or a few process areas for improvement (It's a model, not a standard, like ISO) --Can rate just one area in CMMI
 - -CMMI and ISO are not in conflict: ISO helps satisfy CMMI capabilities; CMMI more rigorous

Key Points for Pre- Appraisals



- Pre-appraisals were "quick-looks", not thorough evaluations
- Pre-appraisals were conducted less formally than a full, third party CMMI appraisal would be
 - More reliance on interviews
 - Less verification of information and document review
 - No maturity ratings determined
 - Results presented as strengths and weaknesses
- Focus of pre-appraisals was on the current processes in use
 - Time constraints did not allow thorough evaluation of documented process, process training, process auditing, or planning and resource allocation for process activities
- Pre-appraisal teams consisted of 3 SEI-authorized appraisers and 3-4 GSFC EPG team members

Differences in the Pre-Appraisals



	#1	#2	#3
Level of Focus	Subsystem	Code 400 Project	Subsystem
Emphasis	Software	Systems Engineering,	Software
Mode	Development Discovery	Acquisition Discovery	Development Verification
1,1000	-1/2 doc. review -1/2 interviews	-Heavy emphasis on interviews	-Few interviews -Lots of doc. review
Draft Findings Briefing Held?	No	Yes	Yes
Interviewee Preparation	Minimal	Gave sample questions	Minimal
Interviewed Support Org's?	No	Yes	No

What Did We Learn In Phase 1?



- The NASA Software Engineering Initiative makes sense for GSFC
 - Our pilot year has identified many areas where improvements are needed
 - The types of improvements identified are ones that have shown considerable "pay-back" in industry
 - Many similar improvements were identified as action items from the Code S/Y Colloquium in July 2002

Components of CMMI Model



